

[I/WE] CLAIM:

1. A system for determining a position and a change in the position of an anatomical structure, comprising:
 - a surgical navigation system;
 - a substrate capable of being removably mounted to an outer surface of a body, wherein the body includes an anatomical structure;
 - a sensor attached to the substrate that can be tracked by the surgical navigation system;
 - a positional device attached to the substrate that determines a position of the anatomical structure;
 - a first circuit for calculating a global position of the anatomical structure by correlating a position of the sensor and the position of the anatomical structure; and
 - a second circuit for displaying the global position of the anatomical structure on a display unit.
2. The system of claim 1, wherein the sensor is an optical tracking device.
3. The system of claim 2, wherein the optical tracking device includes three LED's.
4. The system of claim 1, wherein the anatomical structure is a bony structure.
5. The system of claim 1, wherein multiple positional devices simultaneously track the position of the anatomical structure.
6. The system of claim 1, wherein the positional device is an ultrasonic imaging device.

7. The system of claim 6, wherein the first circuit determines the global position of the anatomical structure without the use of a reference device invasively affixed to the body.

8. The system of claim 6, wherein the ultrasonic imaging device comprises three ultrasound transducers.

9. The system of claim 8, wherein three sonic reflective balls are disposed adjacent the anatomical structure.

10. The system of claim 9, wherein the sonic reflective balls are substantially composed of air.

11. The system of claim 9, wherein the sonic reflective balls are composed of a resorbable material.

12. The system of claim 9, wherein one of the three ultrasound transducers emits an ultrasonic beam, and wherein the ultrasonic beam is reflected by a first sonic reflective ball to the ultrasound transducers.

13. The system of claim 8, wherein three source transducers are disposed adjacent the anatomical structure.

14. The system of claim 13, wherein one of the three source transducers emits an ultrasonic beam, and wherein the ultrasonic beam is received by the ultrasound transducers.

15. The system of claim 6, wherein the first circuit determines the global position of the anatomical structure without the use of an image of the anatomical structure.

16. The system of claim 1, wherein the positional device comprises one fiber and an anchor.

17. The system of claim 16, wherein the fiber includes a serrated portion for the emission of light along a length of the fiber.

18. The system of claim 17, wherein the serrated portion is covered by a light absorbent material.

19. The system of claim 16, wherein the anchor comprises a pin that is removably attached to the anatomical structure, and wherein the fiber is attached to the pin.

20. The system of claim 16, wherein the positional device is connected to a retrieval device.

21. The system of claim 1, wherein the positional device comprises a magnetic transmitter and a magnetic sensor.

22. The system of claim 21, wherein the magnetic sensor includes a pin removably attached to the anatomical structure.

23. The system of claim 21, wherein the magnetic sensor is in a connected relation to a retrieval device.

24. A system for determining a position and a change in the position of an anatomical structure, comprising:

a surgical navigation system;

a substrate capable of being removably mounted to an outer surface of a body, wherein the body includes an anatomical structure;

a sensor attached to the substrate that can be tracked by the surgical navigation system;

an ultrasonic imaging device attached to the substrate that determines a position of the anatomical structure;

a first circuit for calculating a global position of the anatomical structure by correlating a position of the sensor and the position of the anatomical structure, wherein the first circuit determines the global position without the use of an image of the anatomical structure; and

a second circuit for displaying the global position of the anatomical structure.

25. The system of claim 24, wherein the substrate is fixedly mounted to the outer surface of the body using an ultrasonic coupling adhesive.

26. The system of claim 24, wherein the substrate is approximately 5cm in width and approximately 5cm in length.

27. The system of claim 24, wherein the sensor is an optical tracking device.

28. The system of claim 27, wherein the optical tracking device includes three LED's.

29. The system of claim 24, wherein the anatomical structure is a bony structure.

30. The system of claim 24, wherein the first circuit determines the global position of the anatomical structure without the use of a reference device invasively affixed to the body.

31. The system of claim 24, wherein multiple ultrasonic imaging devices simultaneously track the position of the anatomical structure.

32. The system of claim 24, wherein the ultrasonic imaging device comprises three ultrasound transducers

33. The system of claim 32, wherein three sonic reflective balls are disposed adjacent the anatomical structure.

34. The system of claim 33, wherein the sonic reflective balls are substantially composed of air.

35. The system of claim 33, wherein the sonic reflective balls are composed of a resorbable material.

36. The system of claim 33, wherein one of the three ultrasound transducers emits an ultrasonic beam, and wherein the ultrasonic beam is reflected by a first sonic reflective ball to the ultrasound transducers.

37. The system of claim 32, wherein three source transducers are disposed adjacent the anatomical structure.

38. The system of claim 37, wherein one of the three source transducers emits an ultrasonic beam, and wherein the ultrasonic beam is received by the ultrasound transducers.

39. A device for determining a position and a change in the position of an anatomical structure for use with a surgical navigation system, comprising:

a substrate capable of being removably mounted to an outer surface of a body, wherein the body includes an anatomical structure;

a sensor attached to the substrate that can be tracked by the surgical navigation system; and

a positional device attached to the substrate that determines a position of the anatomical structure.

40. The device of claim 39, wherein the sensor is an optical tracking device.

41. The device of claim 40, wherein the optical tracking device includes three LED's.

42. The device of claim 39, wherein the anatomical structure is a bony structure.

43. The device of claim 39, wherein the positional device comprises an ultrasonic imaging device.

44. The device of claim 39, wherein the positional device comprises a magnetic transmitter and a magnetic sensor.

45. The device of claim 44, wherein the magnetic sensor includes an anchor removably attached to the anatomical structure.

46. The device of claim 44, wherein the magnetic sensor is connected to a retrieval device.

47. A system for determining a position and a change in the position of an anatomical structure, comprising:

a surgical navigation system;

a substrate capable of being removably mounted to an outer surface of a body, wherein the body includes an anatomical structure;

a sensor attached to the substrate that can be tracked by the surgical navigation system;

a fiber optic device attached to the substrate that determines a position of the anatomical structure relative to the sensor;

a first circuit for calculating a global position of the anatomical structure by correlating a position of the sensor and the relative position of the anatomical structure; and

a second circuit for displaying the global position of the anatomical structure.

48. The system of claim 47, wherein the sensor is an optical tracking device.

49. The system of claim 48, wherein the optical tracking device includes three LED's.

50. The system of claim 47, wherein the anatomical structure is a bony structure.

51. The system of claim 47, wherein multiple fiber optic devices simultaneously track the position of the anatomical structure.

52. The system of claim 47, wherein the fiber optic device comprises one fiber and an anchor.

53. The system of claim 52, wherein the fiber includes a serrated portion for the emission of light along a length of the fiber.

54. The system of claim 53, wherein the serrated portion is covered by a light absorbent material.

55. The system of claim 52, wherein the anchor comprises a pin that is removably attached to the anatomical structure, and wherein the fiber is attached to the pin.

56. A method for determining a position and a change in the position of an anatomical structure using a surgical navigation system, the method comprising the steps of:

mounting a substrate in a removable manner to an outer surface of a body, the substrate having an associated sensor and having a positional device on the substrate for determining a position of the anatomical structure relative to the sensor, wherein the body includes an anatomical structure; and the sensor can be tracked by the surgical navigation system;

determining the position of the anatomical feature; and

tracking the position of the anatomical structure with the surgical navigation system.

57. The method of claim 56, wherein the sensor is an optical tracking device.

58. The method of claim 57, wherein the optical tracking device includes three LED's.

59. The method of claim 56, wherein the anatomical structure is a bony structure.

60. The method of claim 56, wherein multiple positional devices simultaneously determine the position of the anatomical structure.

61. The method of claim 56, wherein the positional device is an ultrasonic imaging device.

62. The method of claim 61, wherein the ultrasonic imaging device comprises three ultrasound transducers.

63. The method of claim 56, including the step of placing a position indicating structure next to the anatomical structure that interacts with the positional device.

64. The method of claim 63, wherein the position indicating structure is a sonic reflective ball.

65. The method of claim 64, wherein the sonic reflective ball is substantially composed of air.

66. The method of claim 64, wherein the sonic reflective ball is composed of a resorbable material.

67. The method of claim 63, wherein the position indicating structure is three sonic reflective balls.

68. The method of claim 63, wherein the position indicating structure is three source transducers.

69. The method of claim 68, wherein one of the three source transducers emits an ultrasonic beam, and wherein the ultrasonic beam is received by the ultrasound transducers.

70. The method of claim 61, wherein the position of the anatomical structure is tracked without the use of an image of the anatomical structure.

71. The method of claim 56, wherein the position indicating structure comprises one fiber and an anchor.

72. The method of claim 71, wherein the fiber includes a serrated portion for the emission of light along a length of the fiber.

73. The method of claim 72, wherein the serrated portion is covered by a light absorbent material.

74. The method of claim 71, wherein the anchor comprises a pin that is removably attached to the anatomical structure, and wherein the fiber is attached to the pin.

75. The method of claim 71, wherein the position indicating structure is connected to a retrieval device.

76. The method of claim 56, wherein the position indicating structure comprises a magnetic sensor and the positional device is a magnetic transmitter.

77. The method of claim 76, wherein the magnetic sensor includes a pin removably attached to the anatomical structure.

78. The method of claim 76, wherein the magnetic sensor is in a connected relation to a retrieval device.